

GUIDE TO USING THE MONTANA DEPARTMENT OF AGRICULTURE ROTATION MODELING SPREADSHEET

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Disclaimer:

The Montana Department of Agriculture and its staff are not responsible for:

- Decisions made by parties as a result of using of this spreadsheet or the outcome of those decisions,
- errors within the spreadsheet,
- the reasonableness of original estimates and sample rotations contained in the spreadsheet, or
- the outcome of decisions made by parties who use the spreadsheet as a decision tool after making alterations to the spreadsheet.

The Montana Department of Agriculture made considerable efforts in designing and testing the spreadsheet, and measures were taken to prevent accidental alteration of formulas. Spreadsheet users should adjust the assumptions and rotation information to be applicable to their farm and check for errors before making any decisions. Ultimately, spreadsheet users are responsible for their own decisions. Spreadsheet users should avoid changing formulas, but if it is necessary to change formulas, take extreme caution.

Purpose

The Montana Department of Agriculture created the rotation modeling spreadsheet to serve as a tool for farmers to compare the economics of different crop rotations and farming systems (organic/conventional). The spreadsheet allows users to design and compare up to four organic rotations and four conventional rotations. The duration of the rotations can be up to 15 years long. For each crop/year, the user selects field operations to be performed. Up to 15 field operations can be entered for each crop/year. Selected field operations are used to calculate fuel and lubrication costs and to determine time/labor requirements for comparison and planning purposes. Spreadsheet users can use this information to consider the impacts of operations on moisture and to consider equipment needs as it pertains to the timing and synchronization of field operations.

An effort was made to develop reasonable estimates entered into input variables (yellow cells). (*See Documentation of Original Estimates Entered in Assumptions Worksheet*) However the original estimates are generalized and were developed at a point in time approximating conditions for Fall 2007, when markets were strong, but prior to drastic market price increases. The default yield assumptions were based on averages from historic yields over an eleven-year period for a group of three counties (McCone, Phillips, and Valley counties). Users can (*and should*) change these assumptions and estimates to make the spreadsheet calculations applicable to their farm and growing conditions and to reflect their expectations for future years.

General Instructions:

When using the spreadsheet, only modify or enter information in cells with a yellow background in the following worksheets: Assumptions; Organic Rotation 1 – Organic Rotation 4; and Conventional Rotation 1 – Conventional Rotation 4.

Information has already been entered in the yellow spreadsheet cells based on crop and input price levels that existed in early Fall 2007. The information entered is derived from a number of sources (*See Documentation of Original Estimates Entered in Assumptions Worksheet*). This information can (*and should*) be changed to match the production history and conditions of the farm being evaluated. Spreadsheet users should consider whether the default values reflect their expectations for the future.

It is recommended that users work through the spreadsheet in the order of the worksheets. The Assumptions Worksheet is centralized location where assumptions for price, yield, and costs are entered for a wide range of crops on a per-acre basis. The Organic and Conventional Rotation Worksheets (Rotation Worksheets) are where the spreadsheet user designs individual rotations. Information can be entered for up to four organic and four conventional rotations. When a crop is selected for a year in the rotation, the spreadsheet uses information from the Assumptions Worksheet to calculate revenue and expenses. The Rotation Worksheets are designed with some flexibility to allow spreadsheet users to add some expenses that may be specific to the farm, crop, or field for each individual year in the rotation. For example, if raising a particular crop requires the farm to rent an implement or hire a custom operator to complete a field operation, the cost can be entered on a \$/acre basis. The Rotation Worksheets also allow spreadsheet users to specify the field operations that will be performed in individual years. The spreadsheet uses this information to calculate the fuel cost and direct labor requirements for field work (hours/acre). The charts that follow the Rotation Worksheets display and compare the results of calculations made in each Rotation Worksheet.

Yellow Spreadsheet Cells

Information should be entered or changed only in spreadsheet cells with a yellow background. The yellow spreadsheet cells are for variables. The spreadsheet performs calculations in other cells, based on the entries in the yellow cells. Altering cells with a white background will change formulas, which will likely cause calculations to be in error, significantly impacting analysis results.

Many of the spreadsheet cells that contain formulas have a white background and are “locked”. Additionally, some cells and worksheets are hidden to help prevent accidental changes to formulas and avoid confusing spreadsheet users. If the user finds it necessary to change or unhide cells, the individual sheet must be unlocked using the following menu sequence: Tools – Protection – Unprotect Sheet – password = “password”. To look for hidden cells, look at the row number for gaps, highlight the rows on either side of the gap, right click, and choose Unhide. To look for hidden sheets: Format – Sheets – Unhide – select sheet to unhide.

Drop-down Boxes

Drop-down boxes are used to restrict the entries that can be made in the Rotation Worksheets (Organic Rotation 1 – Organic Rotation 4, and Conventional Rotation 1 – Conventional Rotation 4). Drop-down boxes are also used in the Rotation Worksheets to restrict:

- selection of crops for each year in the rotation
- selection of field operations for each year in the rotation
- selection of method of crop management in the Organic Rotation Worksheets (conventional, transitional, and organic)

All drop-down boxes have the option to select a blank entry if no selection is desired; the only way to select a blank entry is by using the drop-down box. If the Rotation Worksheet has information entered into more years than is desired for a rotation, blank entries should be selected for that year's crop, field operations, and crop management method (organic rotations only).

Navigating the Spreadsheet:

WORKSHEETS (in order)	EXPLANATION & INSTRUCTIONS
Disclaimer	Liability disclaimer
Assumptions	<p>The majority of adjustable spreadsheet variables are located in the Assumptions Worksheet (yellow spreadsheet cells).</p> <p>Adjustable variables exist for organic and conventional farming systems, crop, commodity market price, yield, seed cost, herbicide cost, fungicide cost, insecticide cost, crop insurance cost, fertilizer application rate and cost, fuel and lubrication cost, field operation fuel consumption, off-farm commodity trucking cost, organic assessment cost, operating interest cost, net present value discount rate, and machinery capacity (for field operation time requirements).</p>
Organic Rotation 1 Organic Rotation 2 Organic Rotation 3 Organic Rotation 4	<p>These worksheets allow users to design up to four organic rotations.</p> <p>In each worksheet:</p> <ul style="list-style-type: none">• Use drop-down boxes to select the crop management style (blank, conventional, transitional, organic). Select blank entries for years not under consideration.• Use drop-down boxes to select the crop to be grown each year to establish the sequence of the rotation (up to 15 years in length). Select blank entries for years not under consideration. It is recommended that users enter crops for the transition and first complete rotation that will be certified organic.• Use drop-down boxes to select the field operations to be performed for each crop/year in the rotation (up to 15 operations per crop/year). Select "blank" for years not under consideration.• The yield adjustment factor increases or decreases the yield of a particular year (<i>relative to the yield entered in the Assumptions page for a given crop</i>) to allow spreadsheet users to adjust for yield improvements that occur with time following the transition to organic. The yield adjustment factor also allows adjustments to be made to reflect rotational benefits. Examples of how this works: a yield adjustment factor of 100% results in no change, 200% doubles the yield, 50% reduces the yield by half.

Navigating the Spreadsheet:

WORKSHEETS (in order)	EXPLANATION & INSTRUCTIONS
Organic Rotation 1 Organic Rotation 2 Organic Rotation 3 Organic Rotation 4	<p><i>(Continued)</i></p> <ul style="list-style-type: none"> Adjustable variables Land Rent, Custom Hire (Contracted Field Operations), Machine Rent, Direct Labor, and Other Direct Costs allow spreadsheet users to enter additional direct costs that may apply to the crop/year. For purposes of comparison, these costs are relevant only if there is a difference in these costs between methods of farming (organic vs. conventional), crops, or years. The yield, commodity price, direct expenses, and return after direct expenses are shown for each crop/year in the rotation. Commodity prices for the transition period are set to equal conventional commodity prices. Crop yields for the transition period are set to equal organic commodity yields. <p>Rotation Summary Calculations:</p> <ul style="list-style-type: none"> Number of years for Conventional, Transitional, Organic crop management entered (each) Average annual return after direct costs for all years of the rotation; Average annual return after direct costs for years certified organic; Average annual return after direct costs during transition years Net present value of the annual return after direct costs for Year 1 – Year 3 and for Year 1 – Year 4. Direct labor requirements for field operations (hours/acre) for each crop/year.
Conventional Rotation 1 Conventional Rotation 2 Conventional Rotation 3 Conventional Rotation 4	<p>These worksheets allow users to design up to four conventional rotations.</p> <p>In each worksheet:</p> <ul style="list-style-type: none"> Use drop-down boxes to select the crop to be grown each year to establish the sequence of the rotation (up to 15 years in length). Select blank entries for years not under consideration. <ul style="list-style-type: none"> Enter crops for at least four years so that net present value of Year 1 – Year 4 calculates correctly (<i>so in the case of continuous cropping of wheat, wheat would be entered in Year 1, Year 2, Year 3, and Year 4</i>). Enter information so that cycles of a rotation are complete. (<i>For example, if the rotation is wheat – fallow, the following should be entered to accomplish the objectives of presenting full and balanced rotations and entering crops for a minimum of four years: Yr1 – Wheat, Yr2 – Fallow, Yr3 – Wheat, Yr4 – Fallow</i>). Use drop-down boxes to select the field operations to be performed for each year in the rotation (up to 15 operations per crop/year). Select blank entries for years not under consideration.

Navigating the Spreadsheet:

WORKSHEETS (in order)	EXPLANATION & INSTRUCTIONS
Conventional Rotation 1 Conventional Rotation 2 Conventional Rotation 3 Conventional Rotation 4	<p><i>Continued</i></p> <ul style="list-style-type: none"> The yield adjustment factor increases or decreases the yield of a particular year (<i>relative to the yield entered in the Assumptions page for a given crop</i>) to allow spreadsheet users to make adjustments to reflect rotational benefits. Examples of how this works: a yield adjustment factor of 100% results in no change, 200% doubles the yield, 50% reduces the yield by half. Adjustable variables Land Rent, Custom Hire (Contracted Field Operations), Machine Rent, Direct Labor, and Other Direct Costs allow spreadsheet users to enter additional direct costs that may apply to the crop/year. For purposes of comparison, these costs only matter if there is a difference in these costs between methods of farming (organic vs. conventional), crops, or years. The spreadsheet calculates a legume crop fertilizer credit in the year peas or lentils are grown, when peas are plowed down, and in the last year of an alfalfa stand. The amount of credit is based on the value of the nitrogen fixed. The legume crop fertilizer credit appears in the spreadsheet as a “negative expense” (income). As such, this is a non-cash benefit that is not realized in the year presented, but is attributed to the legume crop. If spreadsheet users want this credit to be \$0, the credit amounts (lbs/acre) should be set to zero in the Assumptions Worksheet. The yield, commodity price, direct costs, and return (after direct costs) are shown for each crop/year in the rotation. <p>Rotation Summary Calculations:</p> <ul style="list-style-type: none"> Average annual return after direct costs for the rotation. Net present value of the annual return after direct costs for Year 1 – Year 3 and for Year 1 – Year 4. Direct labor requirements for field operations (hours/acre) for each crop/year.
Rotation Summary	Summarizes the average annual returns (after direct costs) and net present value of Year 1 – Year 3 for organic and conventional rotations. Lists the crop sequence designed for each rotation.
NPV Yr1 – Yr 3 NPV Yr1 – Yr 4 (<i>short-term comparison</i>)	<ul style="list-style-type: none"> Chart that compares the net present value of the annual return after direct costs for Year 1 – Year 3 of all organic and conventional rotations. Chart that compares the net present value of the annual return after direct costs for Year 1 – Year 4 of all organic and conventional rotations.
Trans Through First Rotation (<i>a mid-term comparison</i>)	<p>Chart that compares:</p> <ul style="list-style-type: none"> Organic rotations’ average annual return after direct costs for all years in the rotation designed by the user Conventional rotations’ average annual return after direct costs

Navigating the Spreadsheet:

WORKSHEETS (in order)	EXPLANATION & INSTRUCTIONS
Comparison After Certification <i>(long-term perspective – after certification is achieved)</i>	Chart that compares: <ul style="list-style-type: none"> • Average annual return after direct costs for years in which the crop is certified organic in the rotation designed by the user • Conventional rotations' average annual return after direct costs
Organic Rotation Charts <i>(annual return after direct costs)</i>	Chart that shows the annual return after direct costs for each crop/year of each organic rotation. The following summary information is also presented for each presentation: net present value of annual return after direct costs for Year 1 – Year 3 and Year 1 – Year 4, and average annual return after direct costs is presented for all years, years in which production is certified organic, and transition years.
Conventional Rotation Charts <i>(annual return after direct costs)</i>	Chart that shows the annual return after direct costs for each crop/year of each conventional rotation. The following summary information is also presented for each rotation: net present value of Year 1 – Year 3, net present value of Year 1 – Year 4, and average annual return after direct costs.

Key Comparisons

- Comparisons of Average Annual Return After Direct Costs: In charts that make comparisons, conventional rotations are represented the same in each chart: average annual return after direct costs for the conventional rotation that is designed.
- There are various ways of comparing the returns of organic rotations and conventional rotations.
 - Average Annual Return After Direct Costs – All Years (\$/acre): For a mid-term comparison of average annual returns, this is the best measure to use because it compares the period of transition and first rotation that is certified organic (*if the rotations are set up properly to allow for true comparisons*). This measure can be used to compare organic rotations to each other and to compare organic rotations to conventional rotations. For organic rotations, this compares the average annual return after direct costs for all years, including the transition (*or even years that conventional management is used in the case of a very complex rotation*).
 - Average Annual Return After Direct Costs – Organic (\$/acre): For organic rotations this compares the average annual return after direct costs for years in which certified organic production occurs, making this the best measure to compare organic rotations following the transition period. This comparison is best for comparing organic rotations to conventional rotations from a long term perspective (after transition is complete).
 - If a complex organic rotation is designed that includes years of conventional management, the results of this calculation for that particular organic rotation should be ignored, and the Average Annual Return After Direct Costs - All Years should be used instead for comparison purposes.
 - Average Annual Return After Direct Costs – Transition (\$/acre): This is a good measure for comparison of the decision to convert to organic production in the short-term, in the early years of transitioning a field or farm to certified organic production. This can be used to compare the economics of different transition

strategies and to help determine the opportunity cost (if any) of transitioning to organic. Keep in mind that this measure only averages years in which “Transitional” is selected as the crop management style in the organic rotation sheets. Depending on field history, the transition period could be 0 – 3 years. To be certified, no prohibited substances can be applied 36 months prior to harvest.

- Net Present Value Year 1 – Year 3: For both organic and conventional rotations, this calculates the net present value of the first three years’ return after direct costs. This measure utilizes the concept of the time value of money for determining the opportunity cost of converting to organic since the transition period will occur within the first three years. A weakness in the comparison is that circumstances exist in which transition is achieved in less than three years. Nonetheless, this is a good measure for comparing short-term economics of transitioning to organic to the economics of conventional practices.
- Net Present Value Year 1 – Year 4: For both organic and conventional rotations, this calculates the net present value of the first four years’ return after direct costs. In order for comparisons to be valid, at least four years of information be entered into each rotation. Warning: in order for the calculations of the average annual return after direct costs (discussed previously) to be comparable, complete rotations should be entered, which may require that information be entered in rotations beyond Year 4. The calculation of the net present value for the first four years helps evaluate the opportunity cost of transitioning to organic, but provides a slightly longer period of review (*than the net present value of the first three years*) to account for differences in sequences of fallowing land and speed of achieving organic certification.
 - Net present value calculations for longer periods of time will provide useful information to compare the mid-term economic performance of different rotations and transition strategies, but for the calculations to be comparable, the same number of years must be compared. The spreadsheet’s designer chose not to create a net present value for a longer period to avoid making the spreadsheet less flexible and harder to use. Spreadsheet users who understand what is required to maintain comparability are encouraged to set up net present value calculation for longer periods of time.
- Users can copy information from the crop rotation sheets and paste it into other spreadsheets (*use Paste Special – Values*) to simulate the economics of individual fields within a farm and build a model or plan for transitioning the entire farm.
 - For an example, see *Whole Farm Model.xls* which models the whole-farm economics for a 2,560 acre dryland farm, of which 640 acres are coming out of CRP. The model is from the perspective of a farm corporation operating entity, which cash leases the land it farms. To summarize the results of this model, the early transition period is economically challenging, but after Year 8, the farm transforms from being on the margins of survival (where it was prior to beginning the transition) to having realized substantial improvements in profitability that may make it economically viable in the long term.
 - In this example, all fields are certified after Year 10, with certification being implemented over a long period of time to reflect a conservative transition plan that *attempts* to increase organic acreage gradually, balance acreages of the crops in the rotation, balance income, and

avoid losses during the transition period. To demonstrate the challenge of balancing income and crop acreages when transitioning a farm, the acreages of fields (and crops selected for the fields) are not perfectly even or “matched”.

- The model shows projections for a 20-year period to demonstrate the cyclical nature of net income that results in a situation in which the acreage balances between crops are not symmetrical and to simulate mid to long term economic performance.
- The example does not account for increases in organic yields over time or any changes in commodity prices or input costs.

References & Resources:

Agriculture Canada and Agri-Food Canada – Market Analysis Division Publications
http://www.agr.gc.ca/pol/mad-dam/index_e.php?s1=pubs&page=desc

Alberta Agriculture and Rural Development - Cash Grain Prices
<http://www.agric.gov.ab.ca/app21/grainprices>

Alberta Agriculture and Rural Development – Weekly Crop Market Review
[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/sdd6248](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sdd6248)

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<http://www.agr.gov.sk.ca/apps/MarketTrends/>

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Montana State University Extension Service - Fertilizer Economics webpage
<http://landresources.montana.edu/soilfertility/fertilizereconomics.htm>

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<http://msuextension.org/publications/AgandNaturalResources/EB0161.pdf>

Montana Wheat & Barley Committee – Montana Historical Prices
http://wbc.agr.mt.gov/Producers/pricing_historical_mt.html

North Dakota State University Extension Service – Farm Management Planning Guides
<http://www.ag.ndsu.edu/pubs/ecguides.html>

Organic Agriculture Centre of Canada http://www.organicagcentre.ca/index_e.asp

Rodale Institute Organic Price Report <http://www.rodaleinstitute.org/Organic-Price-Report>

Statpub.com Spot Market Specialty Crop Grower Bids
<http://www.statpub.com/stat/prices/spotbid.html>

Statpub.com Cash Prices <http://www.statpub.com/stat/cash-mkt.html>

Swenson & Haugen, “Projected 2008 Crop Budgets North West North Dakota”, December 2007, North Dakota State University Extension Service
www.ag.ndsu.edu/pubs/agecon/ecguides/nw2008.pdf

University of Saskatchewan Organic Information Website – Organic Crop Acreage Statistics
<http://organic.usask.ca/statistics.htm>

University of Saskatchewan Organic Information Website - Price Data (statistics for Saskatchewan, Alberta, and Manitoba) <http://organic.usask.ca/pricedata.htm>

USDA Agriculture Marketing Service Market News and Transportation Data
<http://www.ams.usda.gov/AMSV1.0/ams.fetchTemplateData.do?template=TemplateB&navID=MarketNewsAndTransportationData&leftNav=MarketNewsAndTransportationData&page=LSMarketNewsPage>

USDA Agriculture Marketing Service Market News and Transportation Data - State Hay Archives
<http://www.ams.usda.gov/AMSV1.0/ams.fetchTemplateData.do?template=TemplateW&navID=RN2HayL1&rightNav1=RN2HayL1&topNav=&leftNav=MarketNewsAndTransportationData&page=SearchHayReports&resultType=&acct=lsmn>

USDA Economic Research Service – Organic Production Data Tables
<http://www.ers.usda.gov/Data/organic/>

USDA National Agriculture Statistics Service - Montana County Yield Statistics
http://www.nass.usda.gov/Statistics_by_State/Montana/index.asp (MT County Level Data – Crops)

USDA National Agriculture Statistics Service - Montana Prices Received, Monthly & Marketing Year Averages and Other Economic Data
http://www.nass.usda.gov/Statistics_by_State/Montana/Publications/econtoc.htm

USDA Risk Management Agency – Federal Crop Insurance Corporation

Summary of Business Database <http://www3.rma.usda.gov/apps/sob/stateCountyCrop.cfm>

Washington State University - Organic Information Resources (including regional statistics)
<http://csanr.wsu.edu/organic/resources.htm>

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“*Flaxseed Production in Montana*”, Montana State University Integrated Pest Management Center / USDA Pest Management Centers / NSF Center for Integrated Pest Management
<http://ipm.montana.edu/MPIN/Cropfiles/flaxseed.htm>

“*Nitrogen Credits from Sod*”, Cornell University
http://nmsp.css.cornell.edu/publications/tables/pdf/N_credits_sods.pdf

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<http://www.ars.usda.gov/Services/docs.htm?docid=10791>